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A Tunable, Single Frequency, Fiber Ring at 1053 nm

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A tunable, single frequency, fiber ring at 1053 nm

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This laser is a tunable source designed for applications where a shorter pulse will be chopped from a long Q-switched pulse by electrooptic modulators, then amplified in Nd:phosphate glass.

The laser employs ytterbium-doped silica fiber as the gain medium, pumped by a laser diode at 980nm. Gain in Yb:silica is distributed over an 90nm range, making it suitable for operation at many wavelengths (1). Our previous experiments with this medium demonstrated oscillation over a 50nm wide band (2). In addition, pumping at 980nm allows the use of stable pump diodes used in erbium-doped fiber amplifiers (EDFA's). To take advantage of this wideband gain medium, and yet operate on a single cavity mode, we designed the laser of figure 1.

A circulator causes unidirectional operation, and allows use of a fiber grating in reflection. This grating has a 0.2 Angstrom bandwidth, and defines the coarse tuning of the laser. It is piezoelectrically stretch tuned to the desired wavelength band (3). A single mode of the cavity is selected by a piezoelectrically tuned fiber grating Fabry-Perot etalon with 64MHz bandwidth.

The laser is Q-switched by a bulk acousto-optic device at 1kHz reprate. The loss is controlled to allow the oscillator to lase close to threshold for 500μs before the Q-switch is turned off completely, creating a pulse (see figure 2). This "pre-lasing" stabilizes the single mode, since Q-switch pulse builds up from the prelase level (4).

To prevent mode hopping during long term operation, cavity length is feedback controlled. Another piezoelectric device stretches a fiber in the cavity according to an error signal derived from the output optical signal.

Due to the long, high loss cavity, the Q-switched pulse is about 300ns long. The central part of this pulse will be gated by an electrooptic modulator to produce a 30ns square pulse, used for further amplification and modulation.

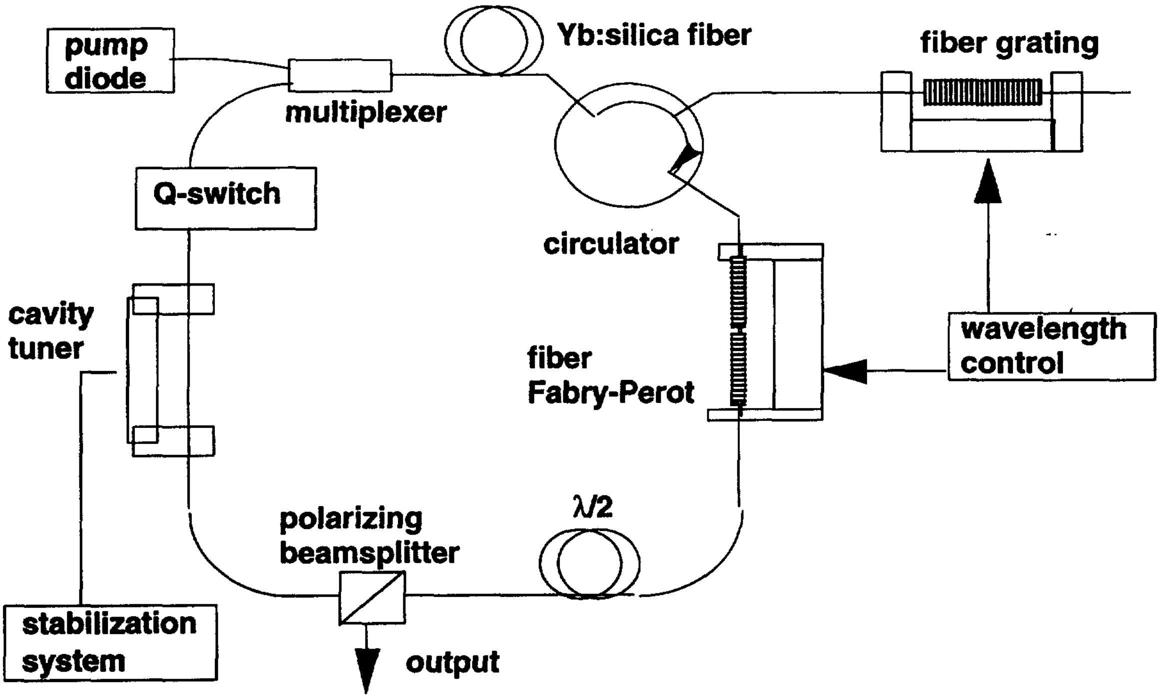

Figure 1. Fiber ring laser optical schematic.

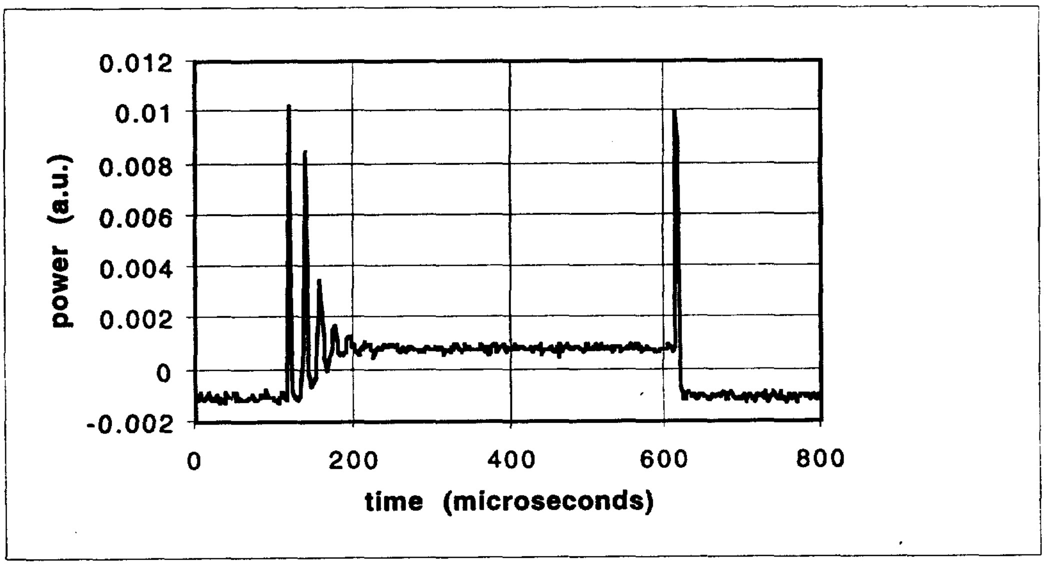

Figure 2. Optical power in laser cavity during stabilization period before Q-switching. Note dampened relaxation oscillations at start.

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